9-19-2002

Field Trip Guide (for the Nebraska Well Drillers Association) Central Nebraska Geology.

Jim Goeke
University of Nebraska-Lincoln, jgoeke1@unl.edu

Bob Diffendal
University of Nebraska-Lincoln, rdiffendal1@unl.edu

Duane A. Eversoll
University of Nebraska-Lincoln, deversoll2@unl.edu

FIELD TRIP GUIDE

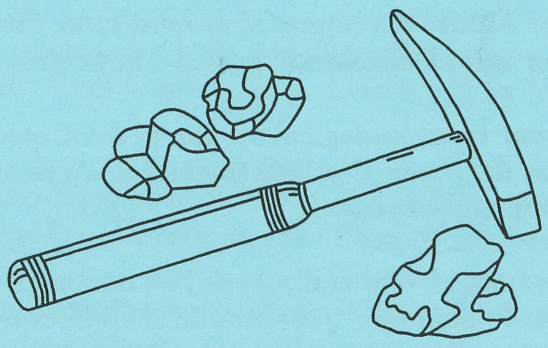
(for the Nebraska Well Drillers Association)

CENTRAL NEBRASKA GEOLOGY

Jim Goeke, Bob Diffendal,

and Duane Eversoll

Conservation and Survey Division



NEBRASKA GEOLOGICAL SURVEY

Conservation and Survey Division
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

University of Nebraska Lincoln

September 19, 2002

IANR

SANDHILLS & CENTRAL NEBRASKA
GEOLOGY FIELD TRIP
September 19, 2002

7:00 a.m. Meet & register at North Platte's Stockman's Motel. On this trip we will view deposits ranging in age from the oldest exposed in the area the Tertiary Brule Formation, through the younger Ogallala Group and Broadwater Formation to the younger Pleistocene and most recent Holocene sediments.
Leave at 7:30 a.m. driving east to Maxwell and then south and view the deep cuts made into the bluffs. Discuss the Tri County Canal and the geology of the area as we continue up thru the canyons. Continue westward to observe the acid rain collection site and learn why it is important to the area and Nebraska. This site sits high in the hills overlooking the Platte River valley. Loess deposits form the tops of the hills. We will discuss how the loess is formed and why it is important to Nebraska's groundwater and agriculture. Return to North Platte and drive westward on I-80. Coffee will be available at one of the stops.

9:30 a.m. Stop to observe outcrops exposed at the Paxton siphon (Sutherland Canal) and Roscoe Gun Club where we will see Holocene, Pleistocene, Pliocene and Ogallala deposits. Continue along the South and North Platte Rivers to northwest of Ogallala to a Lake McConaughy overlook. This area is being heavily developed and water is difficult to obtain. The next stop will be at the Nebraska Games and Parks Visitors Center. The water well for the Center will be discussed. At this site the Nebraska Well Driller's Association in coordination with three drilling firms donated their time and equipment to install the heat pump wells that provide heating and cooling for the facility. The University's Conservation and Survey Division drilled the well for the windmell located just north of the buildings. Future development around Lake McConaughy and the availability of groundwater will be discussed. Lunch will be provided at this location.

1:00 a.m. Drive to the Cedar Point Biological Station of the University of Nebraska-Lincoln to view and discuss the Brule, Ogallala (including a volcanic ash), Pliocene, Pleistocene and more recent loess deposits.

2:30 p.m. Visit the headwaters of Whitetail Creek just northeast of Kingsley Dam to discuss and view the eolian (windblown) deposits and the Pliocene sand and gravel deposits.

3:30 p.m. Drive east along the North Platte River to Sarben then north to Birdwood Creek or another site to be determined. We will discuss springs in the sandhills and their importance to the area and state. We will observe eolian deposits, old buried soils (paleosols) and young stream deposits (alluvial) as we drive back to North Platte.

5:00 p.m. Arrive back in North Platte.

SANDHILLS & CENTRAL NEBRASKA
GEOLOGY FIELD TRIP
September 19, 2002

7:00 a.m. Meet & register at North Platte's Stockman's Motel. Leave at 7:30 and drive south. On this trip we will view deposits ranging in age from the oldest exposed in the area the Tertiary Brule Formation, through the younger Ogallala Group and Broadwater Formation to the younger Pleistocene and most recent Holocene sediments.

8:00 a.m. Observe the acid rain collection site and learn its' history and importance to the area and Nebraska. This site sits high in the hills overlooking the Platte River valley. The hills are topped by the Peoria Loess. We will discuss how the loess is formed and why it is important to Nebraska's groundwater and agriculture. Leave and drive westward.

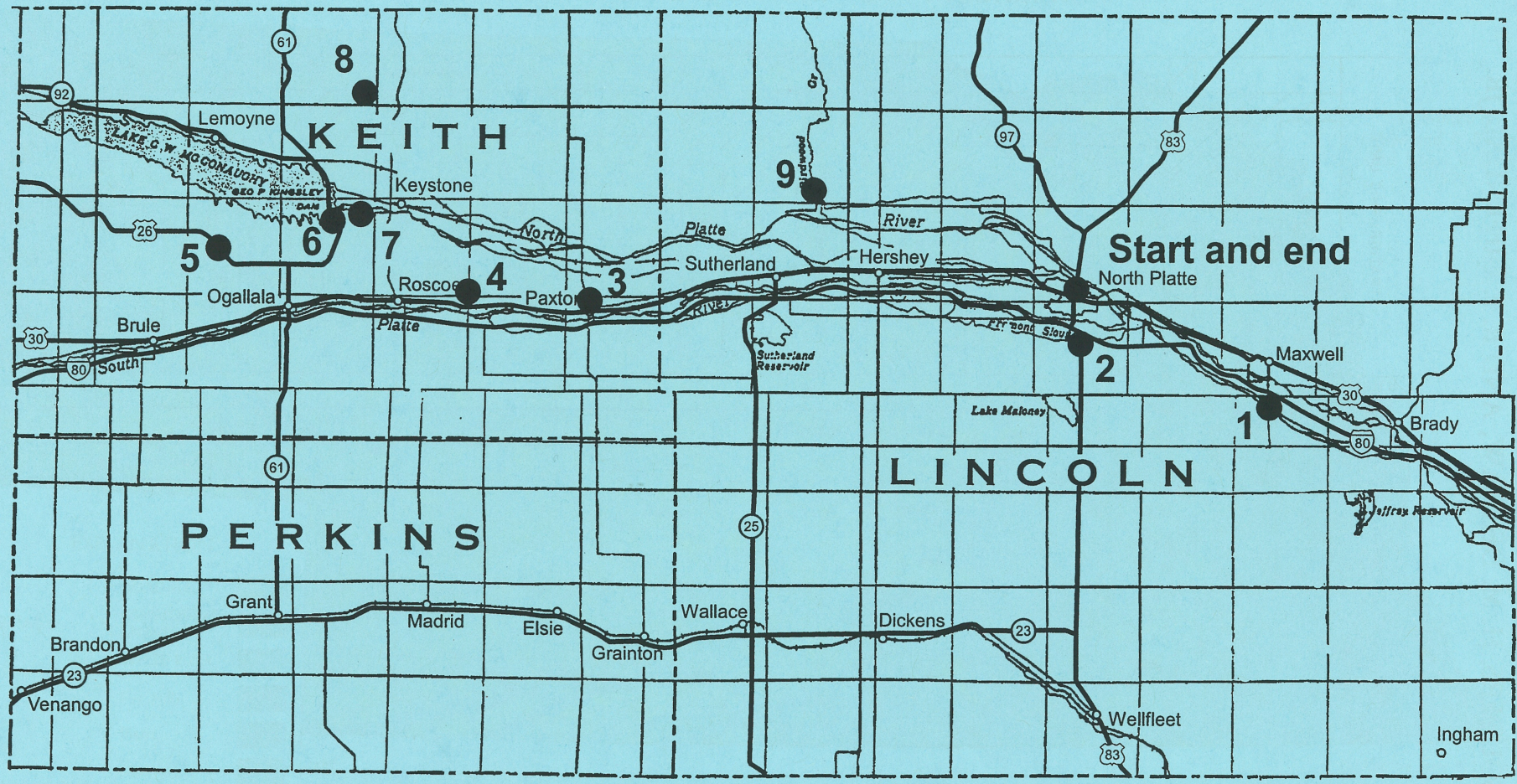
9:00 a.m. Stop to observe outcrops exposed at the Paxton siphon and Roscoe Gun Club where we will see Holocene, Pleistocene and Ogallala deposits. Continue westward along the South and North Platte Rivers to Ogallala and stop at the Nebraska Games and Parks Center. At this site the Nebraska Well Driller's Association in coordination with three drilling firms donated their time and equipment to installed the heat pump wells that provide heating and cooling for the facility. The University's Conservation and Survey Division drilled the well for the windmell located just north of the buildings. Future development around Lake McConaughy and the availability of groundwater will be discussed. Coffee will be available at one of the stops.

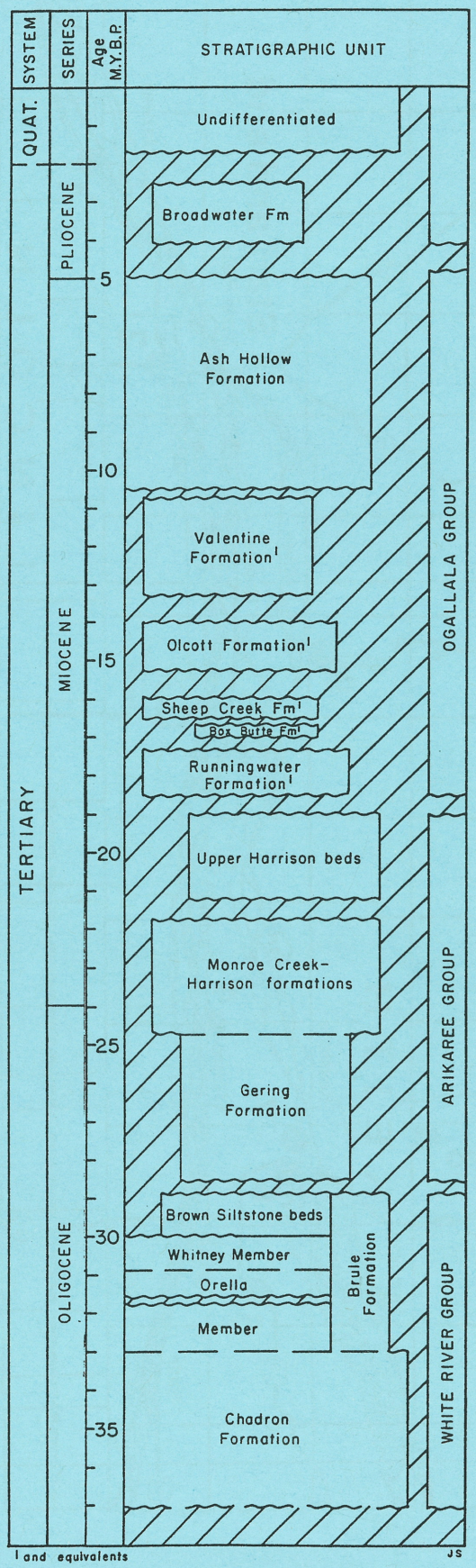
12:00 a.m. Drive to the Cedar Point Biological Station of the University of Nebraska-Lincoln to view and discuss the Brule, Ogallala (including a volcanic ash), Pliocene, Pleistocene and more recent loess deposits. Lunch will be served while we discuss the geology of the area.

2:30 p.m. Visit the headwaters of Whitetail Creek just northeast of Kingsley Dam to discuss and view the eolian deposits and the Pliocene sand and gravel deposits.

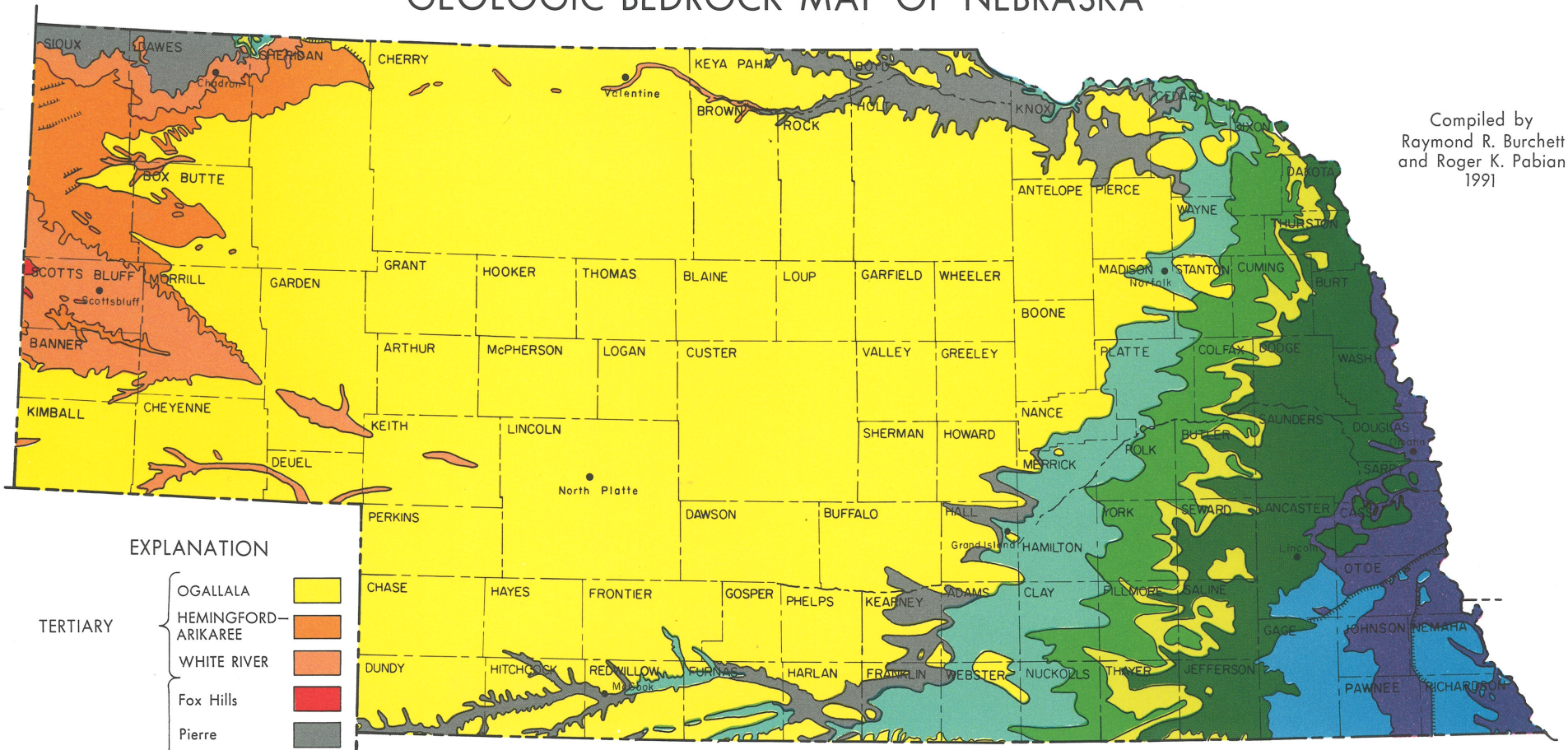
3:30 p.m. Drive east along the North Platte River to Sarben then north to Birdwood Creek or another site to be determined. We will discuss springs in the sandhills and their importance to the area and state. We will observe eolian deposits, old buried soils (Paleosols) and young stream deposits (alluvial) as we drive back to North Platte.

5:00 p.m. Arrive back in North Platte.


KEITH
PERKINS
LINCOLN
Start and end
North Platte
Hershey
Sutherland
Lemoyne
Keystone
Ogallala
Roscoe
Paxton
Brule
South
Platte
North
River
Sutherland Reservoir
Lake Maloney
Maxwell
Brady
Jeffrey Reservoir
Grant
Madrid
Elsie
Grainton
Wallace
Dickens
Brandon
Venango
Wellfleet
Ingham
1
2
3
4
5
6
7
8
9
0 10 20 Miles
0 10 20 30 Kilometers


SYSTEM
SERIES
Age M.Y.B.P.
STRATIGRAPHIC UNIT
QUAT.
PLIOCENE
MIOCENE
OLIGOCENE
TERTIARY
5
10
15
20
25
30
35
Undifferentiated
Broadwater Fm
Ash Hollow Formation
Valentine Formation[1]
Olcott Formation[1]
Sheep Creek Fm[1]
Box Butte Fm[1]
Runningwater Formation[1]
Upper Harrison beds
Monroe Creek-Harrison formations
Gering Formation
Brown Siltstone beds
Whitney Member
Orella Member
Brule Formation
Chadron Formation
OGALLALA GROUP
ARIKAREE GROUP
WHITE RIVER GROUP
[1] and equivalents
JS

GEOLOGIC BEDROCK MAP OF NEBRASKA



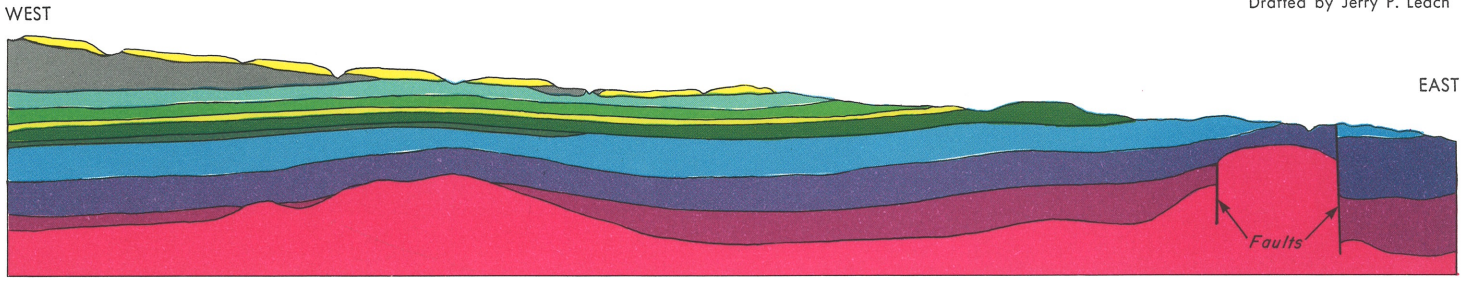
Compiled by
Raymond R. Burchett
and Roger K. Pabian
1991

Drafted by Jerry P. Leach

EXPLANATION

- TERTIARY
  - OGALLALA
  - HEMINGFORD—ARIKAREE
  - WHITE RIVER
- CRETACEOUS
  - Fox Hills
  - Pierre
  - Niobrara
  - Carlile
  - Greenhorn—Graneros
  - DAKOTA
- JURASSIC
- PERMIAN
- PENNSYLVANIAN
- MISSISSIPPIAN
  DEVONIAN
  SILURIAN
  ORDOVICIAN
  CAMBRIAN
- PRECAMBRIAN

Fault



GEOLOGIC CROSS SECTION ALONG SOUTHERN NEBRASKA BORDER

20 0 20 40 60
Scale in Miles

Conservation & Survey Division
Institute of Agriculture and Natural Resources
University of Nebraska—Lincoln

NOTE: Unconsolidated sediments of Recent and Pleistocene age cover the bedrock throughout much of the State and are not shown.

AGE	GEOLOGIC TIME UNITS		ROCK TYPES	MINERAL RESOURCES AND PRODUCTS	TYPICAL FOSSILS
MILLIONS OF YEARS AGO					
1.6	CENOZOIC (RECENT LIFE)	QUATERNARY (Recent and Pleistocene)	Glacial till, silt, clay, sand, gravel, volcanic ash.	Agricultural soil, water, sand & gravel, volcanic ash.	MAMMALS — MAMMOTH
66		TERTIARY	Sandstone, siltstone, clay, gravel, marl, volcanic ash.	Agricultural soil, water, sand & gravel, volcanic ash, riprap & uranium.	
138	MESOZOIC (MIDDLE LIFE)	CRETACEOUS	Chalk, chalky shale, dark shale, varicolored clay, sandstone, conglomerate	Water, oil & gas, cement, brick, agricultural lime, & other construction materials.	REPTILES — DINOSAUR
205		JURASSIC	Subsurface only. Sandstones and shales		PLESIOSAUR
240		TRIASSIC			
290	PALEOZOIC (ANCIENT LIFE)	PERMIAN	Shale, limestone, dolomite, gypsum, anhydrite sandstone, siltstone, chert.	Water, agricultural lime, oil, road rock, riprap.	AMPHIBIANS — BRACHIOPOD
330		PENNSYLVANIAN	Limestone, shale, sandstone, coal.	Oil, cement, brick, concrete aggregate, lightweight aggregate, road rock, agricultural lime, rip rap, water.	
360		MISSISSIPPIAN	Subsurface only. Limestone, dolomite.	Oil, water.	FISH — CORALS
410		DEVONIAN	Subsurface only. Dolomite, gray shale.		
435		SILURIAN	Subsurface only. Dolomite.		INVERTEBRATES — CRINOID
500		ORDOVICIAN	Subsurface only. Dolomite, sandstone, shale.		TRILOBITE
570		CAMBRIAN	Subsurface only. Dolomite, sandstone.		
5,000 ?	CRYPTOZOIC (HIDDEN LIFE)	PRECAMBRIAN	Subsurface only. Granite, other igneous rocks, and metamorphic rocks.		?

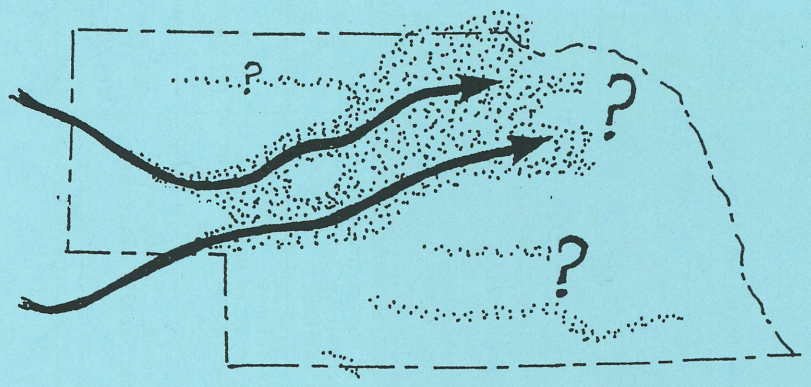
CENOZOIC PALEOGEOGRAPHY OF WESTERN NEBRASKA

Table 1. Dominant lithologic characteristics of Cenozoic stratigraphic units in the study area

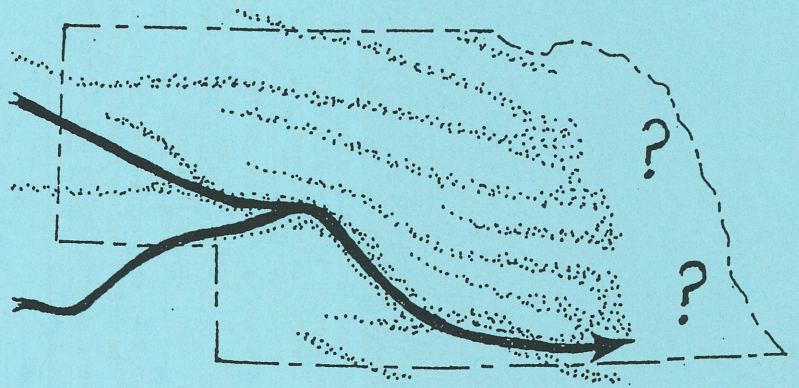
Stratigraphic Unit			Lithologic Characteristics	Maximum Thickness
Quaternary deposits			Sands and gravels along the North and South Platte rivers and beneath adjoining terraces; sands, silts, and minor amounts of gravel from local sources along other streams; sand dunes; and loess.	Extremely variable
Broadwater Formation			Sands, gravels, and some silt and diatomite lenses along north side of North Platte River valley from Wyoming border to Garden County, more silts eastward.	300 ft (91 m)
Ogallala Group	Ash Hollow Formation		North part--gray, olive, and olive-brown fine- to coarse-grained sandstones, some sandy western-source gravels (abundant igneous and metamorphic clasts derived from western plutonic areas), and locally occurring ash beds. South part--gray, brown, and reddish-brown fine- to coarse-grained sandstones, silty sandstones, sandy western-source gravels, siltstones, and locally occurring ash beds. More poorly sorted and more carbonate cement than in north part. Deposits from two parts mingle in Garden and Arthur counties.	600 ft (183 m)
	Valentine Formation		Gray and olive medium- to fine-grained sands and some sandy silts in the northeast. Rocks of equivalent age in the south are brown and gray poorly sorted silty sandstones, sandy silts, and locally occurring gravels mostly derived from local sedimentary sources.	200 ft (61 m)
	Sheep Creek-Olcott formations		Gray, fine- to medium-grained sandstones, poorly sorted silty fine- to coarse-grained sandstones, sandy siltstones, and locally occurring volcanic ash beds. Carbonate cement common.	250 ft (76 m)
	Box Butte Formation		Gray, greenish-gray, and brown clayey (montmorillonitic) silts containing large calcareous nodules that is a good stratigraphic marker in northern Box Butte and southern Dawes counties; overlie locally occurring brown to gray, poorly-sorted silty sandstones and sandy siltstones.	160 ft (49 m)
	Runningwater Formation		Gray, greenish-gray, and brown medium- to fine-grained sandstones, coarse sands, sandy siltstones, western-source gravels, and locally occurring clayey silts and ash beds. Some fine-grained volcaniclastics in west.	350 ft (107 m)
Arikaree Group	Upper Harrison beds		Brown volcaniclastic sandy siltstones. Grayish-brown to gray silty fine-grained sandstones and locally occurring coarser-grained sandstones at the base. Silica-cemented horizons common in west. Generally grades from grayish-brown silty sandstones in west to brown siltstone in northeast.	300 ft (91 m)
	Monroe Creek-Harrison formations		Gray, brownish-gray, and grayish brown volcaniclastic silty very fine-grained sandstones. Generally finer-grained (sandy siltstones) and browner northeastward. Carbonate-cemented horizons ("pipy concretions") common.	420 ft (128 m)
	Gering Formation		Gray, brownish-gray, and grayish-brown volcaniclastic fine- to medium-grained sandstones, silty sandstones, brown sandy silts, and locally occurring beds of ash, coarse sand, and fine gravel. Generally finer-grained and browner northeastward.	350 ft (107 m)
White River Group	Brule Formation	Brown Siltstone beds	Brown volcaniclastic sandy siltstones and silty very fine grained sandstones. Mudstones and fine- to medium-grained sandstones occur locally and generally at or near base. Regionally correlative zone of ash beds (Nonpareil ash zone, new informal name) occurs in lower part.	450 ft (137 m)
		Whitney Member	Brown volcaniclastic siltstones. Mudstones and fine-to medium-grained sandstones occur locally. Contains two regionally correlative ash beds (Upper Ash and Lower Ash) and several less continuous ash beds.	300 ft (91 m)
		Orella Member	Brown to greenish-gray volcaniclastic mudstones and siltstones. Fine- to medium-grained sandstones and thinly bedded mudstones occur in upper part throughout broad areas. Regionally correlative ash bed (M ash, new informal name) occurs in lower part.	400 ft (122 m)
	Chadron Formation		Gray and greenish-gray bentonitic claystones and mudstones. Throughout much of the area fine- to coarse-grained sandstones and locally occurring conglomerates underlie the claystones-mudstones.	300 ft (91 m)

POSTULATED EVOLUTION OF PLATTE RIVER AND RELATED DRAINAGES

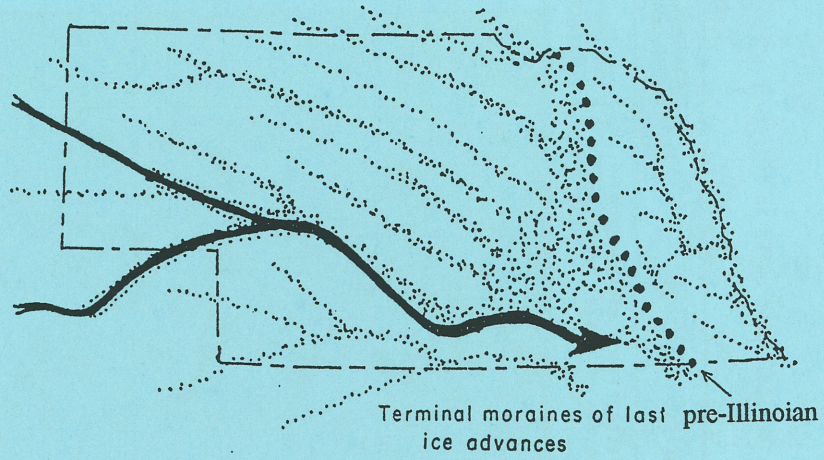
1. Late Pliocene (~2,500,000 yrs ago)



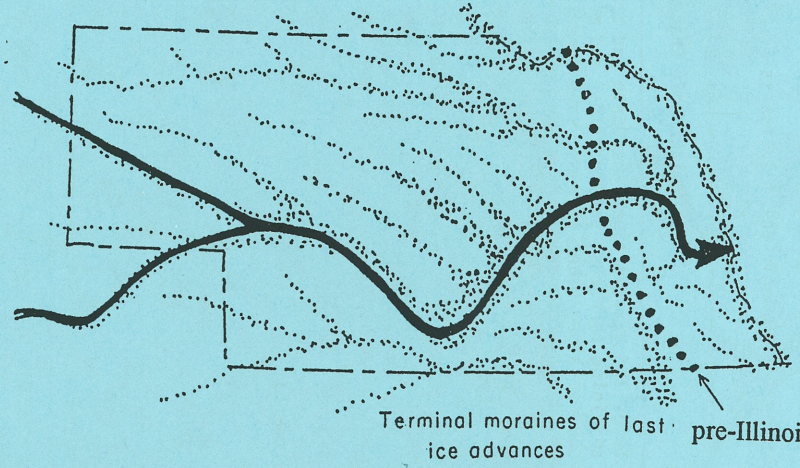
2. Early Pleistocene (~1,600,000 yrs ago)



3. Illinoian (~200,000 yrs ago)



4. Late Wisconsin (~30,000 yrs ago)



Sketch maps of Nebraska indicating postulated drainage patterns when there was no glacial ice in eastern Nebraska. Solid lines show main ancestral Platte drainage. Stippled pattern indicates probable areas of fluvial deposition for a relatively large period of time before and after the suggested dates. Maps compiled from published and work-copy maps and geologic sections by V.L. Souders, J.B. Swinehart, and V.H. Dreeszen of the Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

September 1990

Modified slightly by R.F. Diffendal, Jr., 2000.

IANR

SELECTED REFERENCES

Diffendal, R.F., Jr., 1991, Geologic map showing configuration of the bedrock surface, North Platte 1° x 2° quadrangle, Nebraska: U.S. Geological Survey Miscellaneous Investigations Series Map I-2277, one sheet, scale 1:250,000.

Diffendal, R.F., Jr. and R. Pabian, 1993, Geologic field guide to the Cedar Point Biological Station, Keith County, Nebraska: University of Nebraska, Conservation and Survey Division, Open-File Report OFR-22, 26 p.

Diffendal, R.F., Jr., R.K. Pabian, and J.R. Thomasson, 1996, Geologic history of Ash Hollow State Historical Park, Nebraska: University of Nebraska, Conservation and Survey Division, Educational Circular 5a, 36 p.

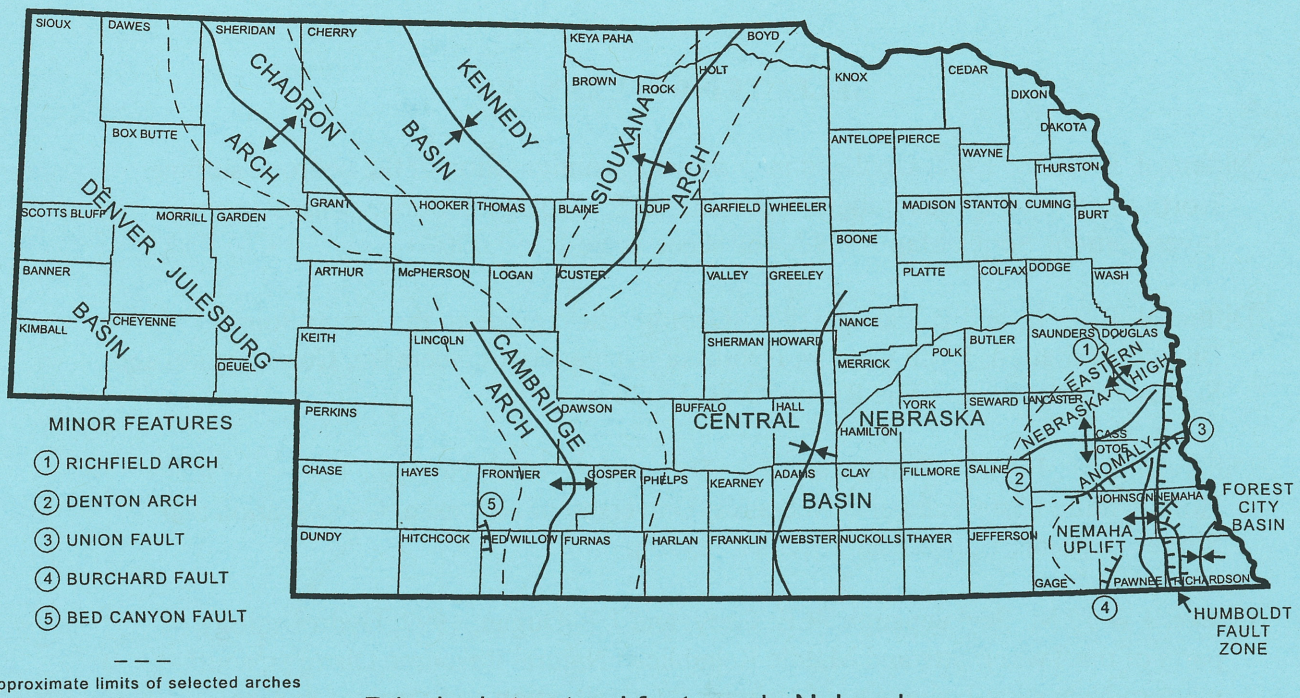
Goeke, J.W., J.M. Peckenpaugh, R.E. Cady, and J.T. Dugan, 1992, Hydrogeology of parts of the Twin Platte and Middle Republican Natural Resource Districts, southwestern Nebraska: University of Nebraska, Conservation and Survey Division, Water Survey Paper WSP-70, 89 p.

Pabian, R.K. and R.F. Diffendal, Jr., 1981, Geology of Lake McConaughy area, Keith County Nebraska: University of Nebraska, Conservation and Survey Division, Field Guide FG-10, 22 p.

Swinehart, J.B. and R.F. Diffendal, Jr., 1997, Geologic map of the Scottsbluff 1° x 2° quadrangle, Nebraska and Colorado: U.S. Geological Survey Geologic Investigations Map I-2545, one sheet, scale 1:250,000.

Swinehart, J,B., V.L. Souders, H.M. DeGraw, and R.F. Diffendal, Jr., 1985, Cenozoic paleogeography of western Nebraska: University of Nebraska, Conservation and Survey Division, Reprint Series RS-52, p. 209-229.

Wenzel, L.K. and H.A. Waite, 1941, Ground water in Keith County, Nebraska: U.S. Geological Survey Water-Supply Paper 848, 68 p.



Principal structural features in Nebraska

AGE		GEOLOGIC TIME UNITS	ROCK TYPES	MINERAL RESOURCES AND PRODUCTS
1.6	CENOZOIC (recent life)	QUATERNARY (Recent and Pleistocene)	Glacial till, silt, clay, sand, gravel, volcanic ash.	Agricultural soil, water, sand and gravel, volcanic ash.
66	CENOZOIC (recent life)	TERTIARY	Sandstone, siltstone, clay, gravel, marl, volcanic ash.	Agricultural soil, water, sand and gravel, volcanic ash, riprap and uranium.
138	MESOZOIC (middle life)	CRETACEOUS	Chalk, chalky shale, dark shale, varicolored clay, sandstone, conglomerate.	Water, oil and gas, cement, brick, agricultural lime, and other construction materials.
205	MESOZOIC (middle life)	JURASSIC	Subsurface only. Sandstones and shales.	
240	MESOZOIC (middle life)	TRIASSIC		
290	PALEOZOIC (ancient life)	PERMIAN	Shale, limestone, dolomite, gypsum, anhydrite sandstone, siltstone, chert.	Water, agricultural lime, oil road rock, riprap.
330	PALEOZOIC (ancient life)	PENNSYLVANIAN	Limestone, shale, sandstone, coal.	Oil, cement, brick, concrete aggregate, lightweight aggregate, road rock, agriculture lime, riprap, water.
360	PALEOZOIC (ancient life)	MISSISSIPPIAN	Subsurface only. Limestone, dolomite.	Oil, water.
410	PALEOZOIC (ancient life)	DEVONIAN	Subsurface only. Dolomite, gray shale.	
435	PALEOZOIC (ancient life)	SILURIAN	Subsurface only. Dolomite.	
500	PALEOZOIC (ancient life)	ORDOVICIAN	Subsurface only. Dolomite, sandstone, shale.	
570	PALEOZOIC (ancient life)	CAMBRIAN	Subsurface only. Dolomite, sandstone.	
5000?	CRYPTOZOIC (hidden life)	PRECAMBRIAN	Subsurface only. Granite, other igneous rocks, and metamorphic rocks.	

Millions of Years Ago

Geologic time chart of Nebraska